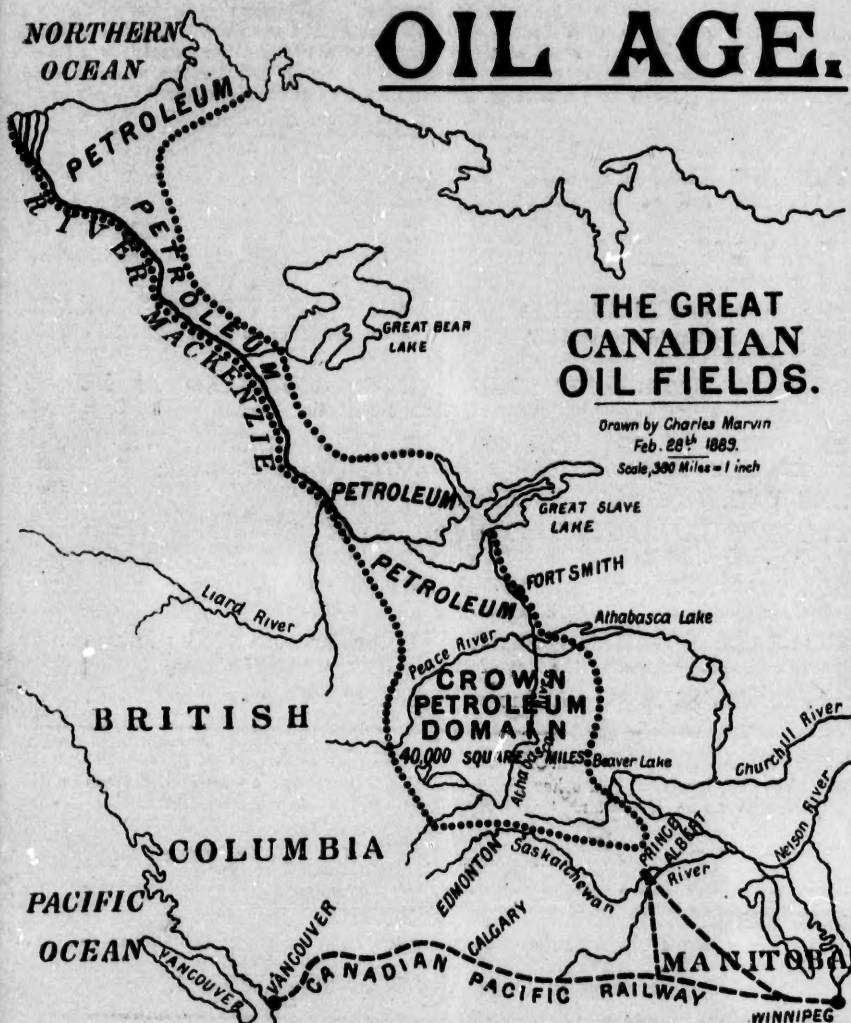


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THE COMING OIL AGE.



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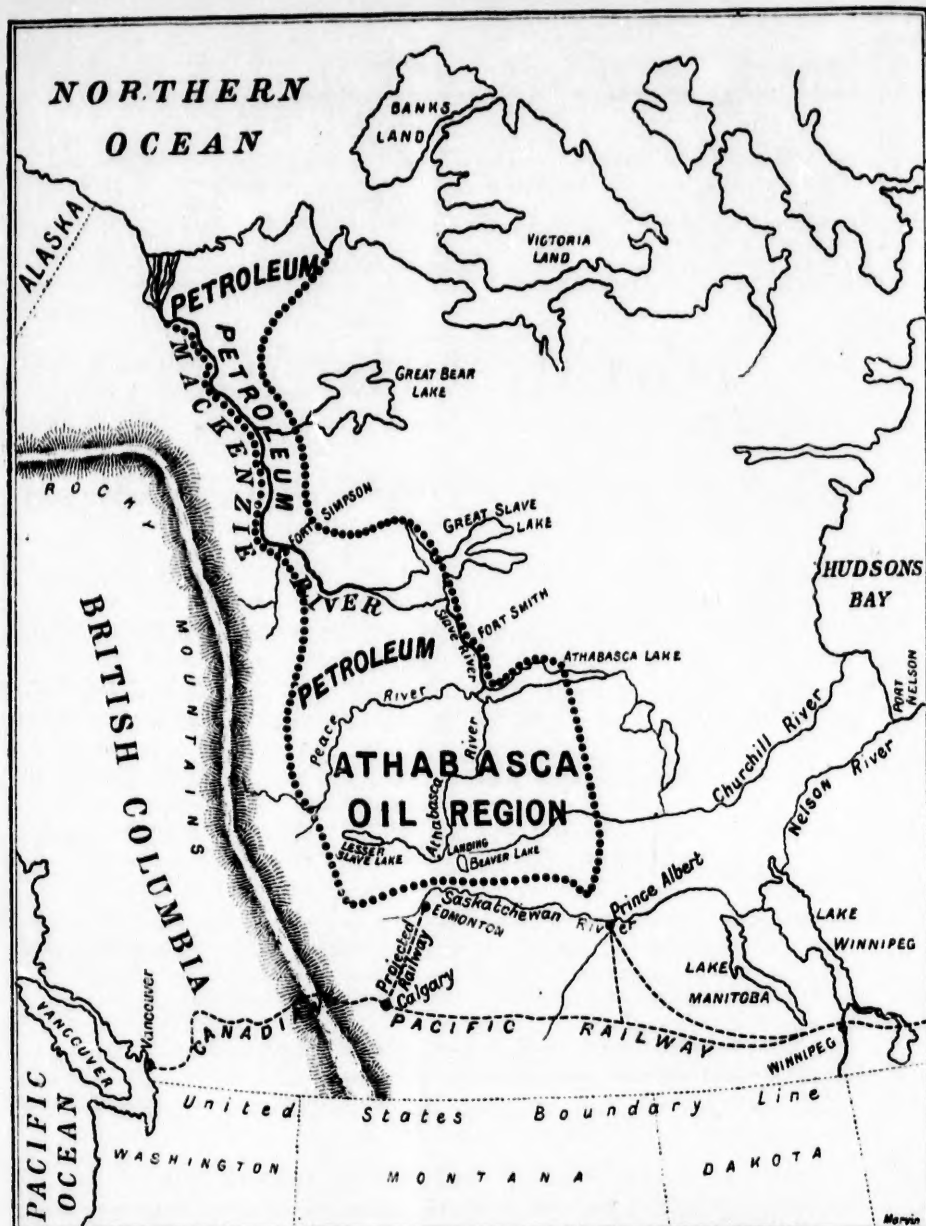
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Drawn by Charles Marvin, Feb'y 28th 1889.

Scale 0 25 50 Miles

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THE
COMING OIL AGE:

PETROLEUM—PAST, PRESENT, AND FUTURE.

BY

CHARLES MARVIN,

AUTHOR OF

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"ENGLAND AS A PETROLEUM POWER," "THE COMING DELUGE OF RUSSIAN PETROLEUM."
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Lecture before the Royal Engineers, Jan. 30, 1889.

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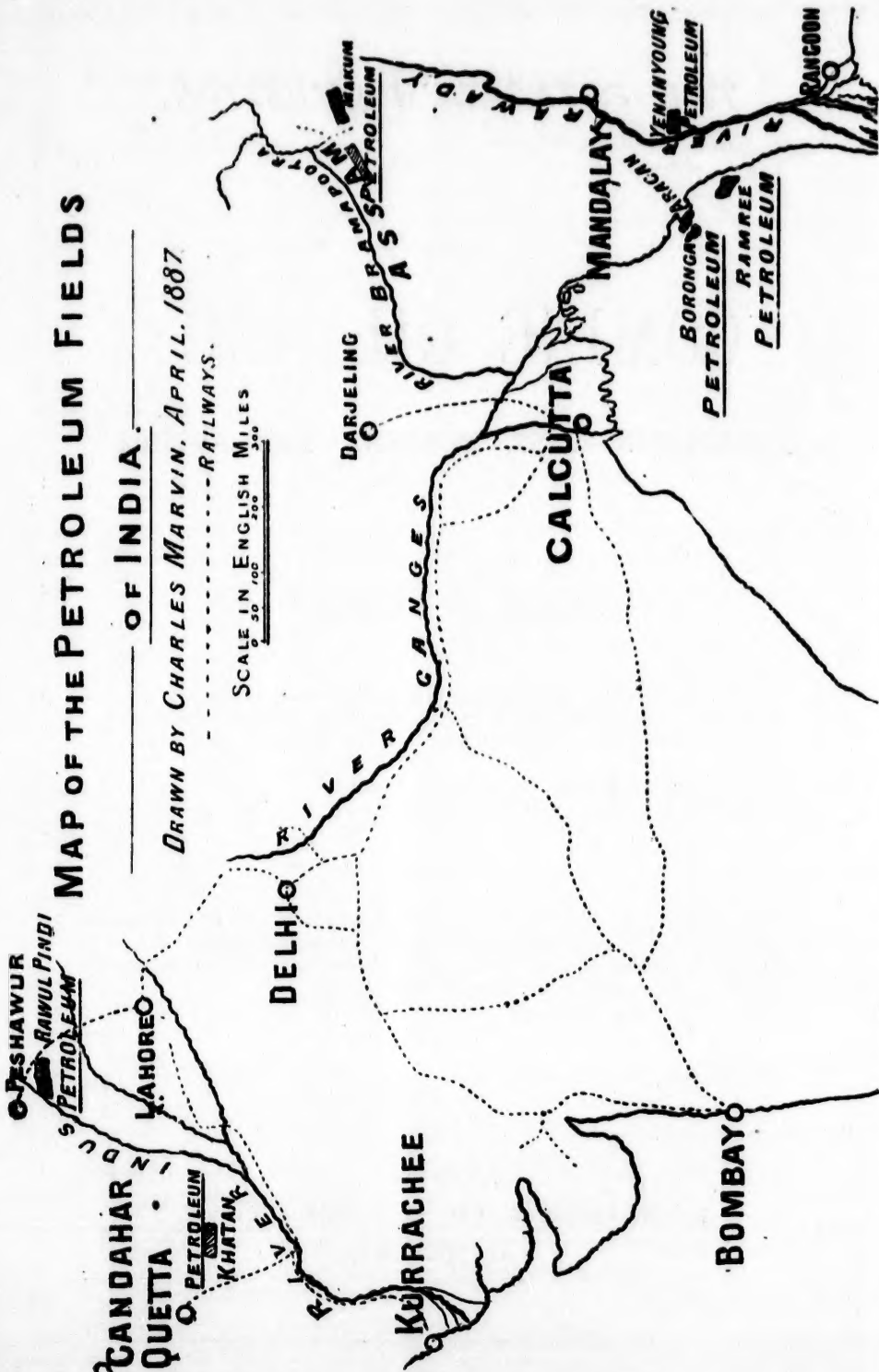
IN,

MAP OF THE PETROLEUM FIELDS OF INDIA.

DRAWN BY CHARLES MARVIN, APRIL, 1887

RAILWAYS.

SCALE IN ENGLISH MILES
0 50 100 200 300



INTRODUCTION.

HAVING been requested by the Government to deliver some lectures last month before the Royal Engineers at Chatham, on Petroleum, dealing with the principal points of the Oil industry, I was compelled to collect many facts, and formulate many generalizations, which, whether included in the lectures or not, I felt would perhaps be of sufficient interest to warrant the issue of a fresh pamphlet. That Petroleum is making rapid headway is a fact pretty generally recognised; but even those actually interested in the trade do not, as I often find, thoroughly realise the enormous strides made by the Mineral Oil industry since the first Petroleum well was bored thirty years ago.

A deal of information (far too much to be included in the present pamphlet) was collected in the course of a three months' stay in Russia last year, during which I paid many visits to the Petroleum Exhibition at St. Petersburg, and had the opportunity of meeting most of the persons interested in the Russian Oil trade, besides others connected with the Continental branches of the industry. That a country, within eight years of Baku becoming known to Europe as an Oil-refining centre, should be able to hold a Petroleum Exhibition, and be able to stand immediately next to the United States as the second Oil-producing power in the world, is a circumstance that should encourage England to turn her attention to the neglected Oil fields of Canada, and the still more scandalously-neglected Oil fields of Burma. It is a national reproach that, owning as we do a larger oil area than the Petroleum fields of the United States and Russia put together, we nevertheless obtain almost every drop of lamp Oil we burn from those two countries, and even allow, to a large extent, the Germans to act as the Oil carriers between those countries and our seaports.

This is a scandal to which I have frequently called attention in the Press, and although not a single Chamber of Commerce has seconded the efforts of the Press to bring about the utilization of one of the grandest assets of the Empire, I am not without hope that this pamphlet may tend to promote energy in the proper quarter. In certain sections of the industry, the policy I have inculcated in Petroleum matters has already resulted in gratifying success. Over and over again I was assured, on my return from Baku in 1883, that the tank steamers common on the Caspian could not stand the rougher waters of the Bay of Biscay and

Atlantic. After much argument and much writing to prove that they could, the first Oil steamer was placed on the Mediterranean in 1885, and now forty-five are being built or are running between America or Batoum and Europe—a marvellous revolution to accomplish in so short a time with a little ink.

In another branch, the success of my Petroleum policy has been even more gratifying, because precious lives, not hard cash, are concerned in the matter. Two years ago, I declared I would no longer tolerate the manufacture of dangerous lamps. "The Moloch of Paraffin" ushered in the agitation against them, and the correctness of my views in regard to what lamps were safe and what were dangerous was confirmed by the independent tribunal appointed by the Russian Government last year. Not a single lamp denounced in "The Moloch of Paraffin" received any medal, while the only lamp that I had found to be absolutely safe was the only lamp in Europe that received a medal for safety. The two aims of this agitation, conducted persistently week after week, and month after month—the improvement of lamps in the direction of safety, and the appointment of a Government Commission to investigate the question—have both been realised. Thanks to the feeling aroused by the Press, scores of new safety appliances have come into existence, and there is every reason to hope that the appointment of Sir Frederick Abel and Mr. Boverton Redwood as Commissioners to report on the various lamps in use, will be followed by the passing of a law to put down the dangerous types, in accordance with the policy advocated in "The Moloch of Paraffin."

In recommending the opening up of the Burmese and Canadian Oil fields, I do not clash so violently with vested interests as when I urged that tank steamers should replace barrel-carrying ships, and that the Birmingham and German lamp manufacturers should be prevented from roasting alive 200 or 300 people with shoddy lamps in the United Kingdom every year. All the same, I would rather be abused, and well abused, than that my recommendations should fall disregarded, for to see one's policy carried into effect is, after all, the best of all salves for the wounds caused by harsh and hostile criticism, in most cases proceeding from simple ignorance.

CHARLES MARVIN.

GROSVENOR HOUSE,
PLUMSTEAD COMMON, KENT,
February 28th, 1889.

THE COMING OIL AGE.

Two Thousand Million Gallons of Oil a year.

BARELY thirty years have elapsed since Colonel Drake started the boom in Petroleum, by successfully sinking the first well for Oil, and, in the interval, the earth has been bored in over 60,000 places, and now yields an annual supply of upwards of Two Thousand Million gallons of "crude"—a yield compared with which the previous supplies of Oil from vegetable and animal sources sink into utter insignificance. In 1886, the 44 vessels employed in whaling to the north of Behring Strait obtained, after a whole season's arduous operations, 20,307 barrels of Oil—a quantity that a single Petroleum well at Baku will often vomit from a ten-inch hole between sunrise and sunset, and vomit as much again during the night, while the drillers sleep. An area as extensive as a big English county, which in olden times would have been devoted a whole year to the raising of crops of Oil-producing seeds, could never at the close of the season's operations have given so large a harvest of lamp Oil as a single foot of soil in a single day often gives in the Caspian Petroleum region. And yet, though year after year the world is bled more and more for Oil, the general supply shows no signs of serious diminution. On the contrary, the older fields are being enlarged, and new fields are being added, which not only fully meet the World's growing demand for Oil, but provide a large reserve for contingencies. The period of vegetable and animal Oils—a period of dear and miserable illumination, is, in nearly all civilized countries, a period that has practically passed away, and, instead, the lighting of those countries is accomplished by the Oil from the rock and the Oil from the desert. Extensive

areas of fertile soil, once devoted to Oil-yielding seeds, can now be more usefully devoted to wheat; and if the old fleets of whalers are dying out, a new fleet of Oil steamers has appeared upon the World's highways, already numbering nearly 150 vessels—a single one of which will convey in a single trip from America to Europe more lamp Oil in its tanks than an entire fleet of whalers, in the happiest days of the whaling industry, ever brought home from the Arctic Seas at the close of a season's operations.

Petroleum new—Gas old.

Thus, when the newspapers tell us that this or the other provincial town has given up gas and electricity for Oil, we must not assume that the inhabitants are lapsing into barbarism. Compared with the vegetable Oil illumination of the ancients, gas, of course, is quite a new and modern method of lighting; but when the comparison is made with Petroleum, it is gas which is old, and Mineral Oil which is new, for a century has elapsed since Murdoch invented gas, while the burning of refined Earth Oil in lamps goes back no further than the period of the Crimean War. And what a progress since! Drake put down the first tiny tube in 1859, and now the world's production of crude Oil is such that, if at the end of the year it were placed in the blue Petroleum barrels familiar to everybody, and those barrels were placed end to end, they would occupy a line more than 10,000 miles long, and stretch further than from New York to Pekin, *viâ* London, Moscow, and Tobolsk. Truly a marvellous development in so short a time, and one that will stand comparison with that of the electric light. And yet it is a progress that must make England blush, for while the United States and Russia—even sluggish, and in business matters (in the estimation of the Solomons of London), barbarous Russia—while those two countries have each of them opened up their Petroleum fields, and employ tens of thousands of people in supplying the world with light, and grease, and fuel, England, possessing the largest Oil deposits in the world in Canada, and the largest deposits in Asia in Burma, is content to burn Russian Oil

and American Oil, and makes no attempt to exploit those Petroleum treasures which have been bestowed upon her by a bountiful Providence.

"Strike (Oil)" but hear me!

Last year the United Kingdom imported 1,835,274 barrels of refined Petroleum Oil, equal to 74 million gallons, from the United States and Russia. The wholesale value of this was about two millions sterling. Leaving other parts of the Empire out of consideration, India imported over 29 million gallons of Oil from Russia and the United States, the estimated value of the Oil imported there being fixed at about one million sterling. In this manner England and India together imported over 100 million gallons of lamp Oil, valued at about three millions sterling, and made not a single solitary effort to take any portion of this trade out of the hands of the Russians and the Americans, in spite of possessing Petroleum fields infinitely superior in magnitude to both. If the Americans have had a control of the European Oil market for a quarter of a century, it is only five years ago since the Russians put in an appearance, yet the Oil exports of all kinds of Russia now amount to over 100 million gallons a year. The only thing to be said in extenuation of England is, that the great Oil fields of Western Canada have only become known within the last three years, while the Oil fields of Upper Burma have only been included within the Empire since the acquisition of the country from King Theebaw. All the same, England has found time in the interval to arrange the exploitation of the Ruby mines of Burma, although situated in an unsettled district, 200 miles by road from Mandalay, whereas the Yenangyoung Oil fields are disposed on the very banks of the river Irawady, close to the old frontier, and only 60 miles from the Prome Railway. King Theebaw received £20,000 a year revenue from the Ruby mines; the Streeter Syndicate will give the Indian Government double. This is a mere bagatelle compared with what Petroleum might yield in revenue if properly fostered by the Indian authorities.

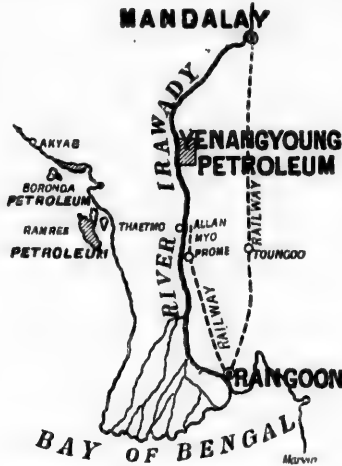
Simla should copy Russia.

In support of what I say let me quote the case of Russia. Formerly nearly all the Kerosene consumed in Russia was American. In 1873 the importation amounted to $13\frac{1}{2}$ million gallons of Kerosene. At that time there existed an excise tax on Kerosene, similar in the method of levying it to the excise tax imposed last year in India. Certain Russian publicists commenced an agitation, and a very wise agitation, I think, in favour of removing the tax from the home article, and confining it to the foreign. Accordingly the Russian Oil was allowed to go free, while foreign Kerosene was subjected to a duty of about 7d. a gallon (Victoria and New South Wales each maintain a duty of 6d. per gallon to protect the Australian Shale Oil industry), which is still in vogue. The result was that the importation of American Kerosene into Russia, 13,500,000 gallons in 1873, rapidly decreased, until in 1887 it was only 50,000 gallons! On the other hand Baku, which produced only $4\frac{1}{2}$ million gallons of Kerosene in 1872, produced in 1887 nearly $204\frac{1}{2}$ million gallons of Kerosene! The native industry having thus become firmly established, the Russian Government, to make up for the loss of revenue occasioned by the collapse of the American Oil imports, imposed last year a new excise tax of about 2d. a gallon. This is expected, according to the Minister of Finance's estimate, to bring in a revenue of eight million roubles, or £800,000 a year. After this, how insignificant the £40,000 England and India have made such a fuss about getting in revenue from the famous Ruby mines. What Russia has done, and done mainly within the last ten years, India ought to do and do without further delay. That is a policy English public opinion should press upon Simla.

Favouring the Mole Hill instead of the Mountain.

Up to now the Indian Government, with curious perversity, has confined its efforts to prodding two or three underground puddles

of Oil in Beluchistan, in a hopelessly bad position for industrial



BURMESE OIL FIELDS AND THE NEW RAILWAY
TO MANDALAY.

development, while totally neglecting the submarine seas of Oil that underlie the Irawady, in sight of that river and within 60 miles of the Burmese railway system. These enjoy an easy and organised access to the sea, and occupy a splendid midway position between the 300,000,000 Oil consumers of India and the 400,000,000 Oil consumers of China. The early wells of America were sunk where the Indians had been accustomed from time immemorial to obtain Oil from the surface pools.

The Russians, on their part, concentrated their energies on the Oil pits of Baku, which for thousands of years had been known to and worked by the Persians. Having come into possession of the famous "King's Wells" of Burma, from which also for thousands of years Oil has been extracted from pits, one would have thought that the Indian Government, imitating America and Russia, would have sunk wells where the Oil was known to be in abundance, instead of poking about in a totally new locality, from which no Oil had ever been exported, and where its existence was simply a matter of surmise. However, it is to be trusted that no further time and money will be wasted on academical operations of this kind, and that the authorities will concentrate their attention properly upon Burma. Any Oil fuel required for the Indus-Quetta lines can be easily sent by tank steamer to Kurratchee from the Irawady, and the Beluchistan Petroleum fields left for the moment in peace. Later on, when the Yenangyoung fields are well in hand, State and private enterprise can be directed elsewhere. Burma is dotted with Oil indications, but I select the Yenangyoung fields because they are the oldest and largest, and lie close to the river and sea.

Sending Coal to Newcastle.

Last year Burma imported 1,000,000 gallons of Kerosene from Russia. That Oil had to travel by railway 560 miles from the Caspian to Batoum, crossing a difficult pass, 3200 feet high, and had to journey *via* the Suez Canal to Rangoon. The trade was quite a new one. The first Russian Oil arrived in India in 1885, when 4000 or 5000 gallons were landed at Bombay. In 1887 the total was over six million gallons. The influx of cheap Russian Oil is having the effect of rapidly crushing the native manufacture of lamp Oil from seeds, &c., that has prevailed in India from time immemorial. To make good this decay of the vegetable Oil industry, the course that the Indian Government ought to adopt is clear. Indian-made Kerosene ought to be exempt from taxation, and the existing Kerosene tax confined to the foreign article. This would give Burma the same chance that Russia gave Baku. When the Russian Government freed the native industry from impost, Baku was practically in the same condition as Burma to-day, for the ancient Persian Oil pits at Baku in 1872 had only been supplemented by a couple of experimental bores, and the total yield of crude Oil was but a trifle over six million gallons for that year. Nearly a million gallons more than this quantity was extracted from the ancient Burmese pits at Yenangyoung last year. Until tube wells were sunk at Baku, nobody had any idea of the extraordinary copiousness of the supply. There is no reason why this copiousness should not be repeated in Burma, and render India the Petrolia of Asia.

India's Interests are England's Interests.

The indirect benefit to trade in England by the development of the Burmese Oil fields (the Yenangyoung deposits are simply one of many Oil fields in Burma) cannot be too strongly insisted upon. The development of the Russian industry has meant the pur-

chase of 100 tank steamers for the Caspian, as many more steamers and tank barges for the Volga, several hundred miles of pipe line and Oil tubing, 7000 or 8000 tank cars for the railways, and the erection of several hundred tank reservoirs (storing collectively 120,000,000 gallons of Kerosene), while giving employment at Baku alone to 10,000 hands. The Russian industry has been developed by the Swedes, and Germans, and Russians, and they have given their orders largely to their own countrymen. Similarly English trade would doubtless in turn benefit if the English developed the Oil industry of Burma. The Chambers of Commerce of Glasgow, Newcastle, and Birmingham should therefore, in the interests of the localities concerned, urge on the Home and Indian authorities the development of the Burmese Oil fields. If I mention that a considerable mileage of the pipe lines at Baku has, in spite of German competition, been supplied by the Glasgow firm of Messrs. Andrew and James Stewart, Limited, of the Clyde Tube Works—Oil pipes of British manufacture being, in the general opinion of Russian experts at the St. Petersburg Petroleum Exhibition last year, the best in Europe—it will be seen that the matter is of as great an importance to Scotland as the construction of tank steamers is to Newcastle, and the manufacture of lamps to Birmingham. Messrs. Stewart easily turn out a mile of wrought-iron Oil pipe a day, standing a pressure of 1800 lbs. to the square inch. A mile a day seems a deal, yet if this firm doubled or trebled their output, which they could readily do with their resources, it would take a long time for Glasgow to overtake the 6000 miles of pipe lines existing in America alone, without reckoning the many thousand miles of well tubing. England hesitates about sinking a few wells in Burma. In America nothing is thought of sinking hundreds of wells every year, and 53,000 have been sunk there altogether since 1859.

Heavy Oils Coming to the Front.

Petroleum differs in character in every country and in almost every district. It is a trite fact in the Oil trade that American

crude produces twice as much lamp Oil as the Russian or Burmese crude. While this is true as regards the older Pennsylvanian Oil fields, the newer Lima wells of Ohio yield no more Kerosene from their crude than that of Baku. Apart from this, the heavier Oils of Russia and Burma are rapidly appreciating to an extent that must at no distant date render them more valuable than those of America. The generality of lamps in use were invented to burn the lighter Oil of America (.800 specific gravity), and to meet their requirements Russia has to send to the market Kerosene no heavier than .820 specific gravity, of which she can only get 30 per cent. from her crude, whereas, if the lamps in use burnt Oil of .870 specific gravity, she could produce more than twice as much from her crude Oil. Had Russian Oil come into the market first thirty years ago, instead of American, this would have been the kind of Oil she would have supplied, and lamps would have been invented to burn it. Being a late comer she has had to furnish an Oil that the lamps in use will burn, under pain of having it returned on her hands. The result is that hundreds of millions of gallons of heavy lamp Oil have been barbarously burnt in Russia as fuel. To remedy this state of things, which has repeatedly evoked the indignation of Professor Mendelaieff, the Russian Government has offered two prizes, of 2500 and 1000 roubles respectively, for the best poor and rich man's lamp, to burn .870 Oil. As this Oil is not obtainable in this country, I would refer (to put a stop to the constant inquiries addressed to myself) those who are interested in the subject to Messrs. Blumann and Stern, 43, London Wall, E.C., the London agents of the Baku firm of Shibajeff & Co. The Shibajeff firm have made a speciality of heavy Oils (they manufacture 18,000,000 gallons of burning and lubricating Oils yearly), and the scientific collection of Oil products displayed by their manager, Victor Ragsine, at the St. Petersburg Petroleum Exhibition last year, testified to the interest he has always taken in this important question. It is thanks to him and Professor Mendelaieff that it has attained its present prominence.*

* While passing this through the press my attention has been called by Dr. Thorne to a new miner's lamp he has invented for burning heavy Mineral Oil, yielding a considerably greater light than the present lamps in use, and much safer.

All Lamps will some day Burn Heavy Oil.

It would be a mistake, however, to imagine that the question is one that concerns only a particular firm or two—it is of the gravest importance, not only to Russia, but to Burma, and not only to Russia and Burma, but to the whole Petroleum trade generally. In 1887 Russia produced a little over 200,000,000 gallons of Kerosene. Had heavy oil lamps been in vogue in Europe, instead of lamps made for the American type of Oil, that production would have been over 400 million gallons instead of 200. But while no lamp has yet been produced easily burning under every conceivable circumstances Oil of $\cdot 870$ specific gravity, the whole tendency of modern lamp inventions is to work up to that standard. For instance, the old-fashioned double wick, or duplex, lamps will not burn Oil of even $\cdot 830$ specific gravity (ordinary American Kerosene has a specific gravity of $\cdot 800$, and Russian of $\cdot 820$), but the newer-type, large flame lamps—such as the English Defries and the Russian Kumberg—burnt easily, night after night, for weeks together, at the Petroleum Exhibition, pyronaphtha, a Russian Oil of $\cdot 858$ specific gravity. The more, therefore, circular wick lamps of great flame-power (40 to 100 candle power, as compared with the 25 candle power of the duplex) supersede duplex lamps, the better prepared the European market becomes for heavier Oils. And this is a very important matter, because these heavy Oils are not only odourless, but have such a high flashing point that they are safer to store than even Colza or any vegetable Oil. This is a matter of special significance for the East, where certain kinds of Kerosene—safe enough in the more temperate climate of America—flash and ignite in storage in India; involving, therefore, the manufacture of a different kind of Kerosene for the Indian market. Even this Oil is dangerous compared with the heavy safe Oil Burma could supply in limitless quantities. So far, therefore, from the heavy character of Burmese Oil being a defect, it is quality which every day becomes increasingly precious; and the more the question of heavy oil lamps approaches solution in

Europe, the more valuable the Burmese Oil deposits become for the hot regions of Asia. Such being the case, the Indian Government ought also to offer rewards to promote the solution of the problem.

The Canadian Oil Industry.

Having thus demonstrated the importance of those Burmese Oil fields, of which the Director of the Geological Survey of India writes:—"I think it is a safe prophecy that the Oil measures of "Eastern India may be supplying half the world with light, within "a measurable time," I will pass on to describe the new Petroleum fields of Canada. These are quite distinct from, and remote from, the older deposits of Ontario, being situated in the Mackenzie Basin, in the Western territory of the Dominion. The Ontario Oil deposits cover an area of 50 by 100 miles, but the developed fields are confined to a belt two miles in width and 16 in length, situated about 16 miles east of Port Sarnia, and extending nearly parallel with the St. Clair River. The territory is divided

into two districts, about seven miles apart, called Petrolia and Oil Springs, in which, collectively, 3200 wells have been sunk. Petrolia produces the greater proportion of the 25 million gallons obtained every year, and also owns 9 out of the 13 refineries at work in Canada. Although, when compared with the United States, where the average production of crude amounts to about 1000 million gallons every year, the industry may seem insignificant, it yet gives



THE LESSER CANADIAN OIL FIELDS.

employment to 8000 men, and sustains a population of 8000. The capital invested in the Oil business is estimated at £572,000, and the total value of the Oil output annually at £400,000. The industry is protected by a duty of $7\frac{1}{2}$ cents per gallon, but it does not furnish a supply adequate to the wants of Canada, and in 1887 the imports of crude and refined Oil from the United States amounted to 4,465,044 gallons, valued at about £86,000.

The Largest Oil Fields in the World.

It is not, however, to the steady thriving Oil industry of Ontario that I desire to call attention, but to the newly-discovered deposits in the great Mackenzie Basin, respecting which the Select Committee of the Senate of Canada appointed to enquire into the resources of the region, reported last year that: "The evidence submitted to your Committee, points to the existence in the Athabasca and Mackenzie Valleys of the most extensive Petroleum field in America, if not in the world. The uses of Petroleum, and consequently the demand for it, are increasing at such a rapid ratio that it is probable that this great Petroleum field will assume an enormous value in the near future, and will rank among the chief assets comprised in the Crown domain of the dominion. For this reason your Committee would suggest that a tract of about 40,000 square miles" (the area of the Russian deposits at Baku is only 1600 square miles) "be, for the present, reserved from sale, and that as soon as possible its value may be more accurately tested by exploration and practical tests; the said reserve to be bounded as follows: Easterly by a line drawn due north from the foot of the Cascade Rapids on Clearwater River to the south shore of the Athabasca Lake; northerly, by the said lake shore and the Quatre Fourche and Peace Rivers; westerly, by Peace River and a straight line from Peace River Landing to the western extremity of Lesser Slave Lake; and southerly by said lake and the river discharging it, to Athabasca River and Clearwater River as far as the place of beginning."

Do not see it as well for Canada.

Canada's Oil Domain.

The area of 40,000 miles recommended to be reserved by no means represents the total, which one witness estimated at 100,000 miles of Oil-bearing territory. To avoid minute details of a region of which few maps in England give an accurate representation, I may say, in general terms, that if the reader find Calgary, a well-known station on the Canadian Pacific Railway, and strike about a couple of hundred miles due north to Edmonton (which is connected with the station by a coach road) he will reach the fringe of this great Oil region. From the Edmonton district, the Oil belt stretches the whole distance in a north-westerly direction to the mouth of the Mackenzie River, a length of quite 2000 miles as the crow flies. The Athabasca River runs through the middle of the Oil district, which includes the whole of the Lesser Slave Lake on the one hand, and touches the shores of the Beaver Lake on the other. The Peace River is entirely included in the district, from the moment it quits the Rocky Mountains, until with the Athabasca it flows into the Great Slave Lake, a course of over a thousand miles; and from Fort Smith, close to where they jointly flow into the lake, to the mouth of the Mackenzie River, a navigable run of 1360 miles, there is Oil the whole way. The general area is larger than that of all the Petroleum districts of the present Oil-producing countries put together, and the selection of the best southern section as a Crown domain is a measure that should be copied by the Indian Government without delay. A single well at Baku has spouted Oil worth a million sterling from a bit of land originally bought for a few roubles, and it is not fair to India that speculators should be able to purchase for a few rupees, from ignorant natives, the best sites of the Oil wells of Burma.

Will no one go West for Oil?

In the book of Genesis (chapter vi., 14th verse) we are told that God commanded Noah to avail himself of the resources of some local Petroleum field, and "pitch the Ark within and without with Pitch." It is to this extent only that the Athabasca Oil

fields are being utilized by England to-day, her traders in that region merely using a little of the surface pitch of the Petroleum deposits to "pitch" their vessels "within and without," while she is content to leave the largest Oil fields in the world to them and a scattering of Canadian colonists, and import yearly two millions' worth of Petroleum from the United States and Russia. In extenuation, it may be said that the completion of the Pacific Railway has only quite recently brought the country within reach of the world's steam communications. At no distant date Edmonton will be connected with Calgary by railway, as well as Athabasca Landing, 90 miles further north. This has been recommended as a good point for commencing operations, on account of its connection with the water communications of the Mackenzie River and Hudson Bay. Another outlet is available by means of the Saskatchewan. Thirty miles from the Grand Rapids, according to Professor Bell, there is a visible Petroleum field stretching 10 miles along the river. Wells would easily strike Oil at 400 feet or so at this spot. From here there is a steamboat run of 125 miles to Athabasca Landing, and, pending the railway, a pipe line 90 miles long (a mere trifling as pipe lines go) would bring it to the Saskatchewan River, where it would touch the water communications, running to the Canadian Lakes, meeting on its way down the river the railway system at Battleford or Prince Albert when complete.

A Choice of Hot and Cold Oil Fields.

We may therefore say that this great Oil region has two sea outlets, *viâ* the Mackenzie River and Hudson Bay, a lake outlet by means of the Saskatchewan, and, in embryo, two railway outlets by way of Edmonton and Calgary on the west, and Battleford or Prince Albert on the east. Climatically, it may be said that although a deal lies in northern latitudes, yet, owing to the warm currents of air from the Pacific—a well-known peculiarity of the region—the whole of the 40,000 miles of the proposed Oil domain compares favourably with Middle and even Southern Russia. The Mackenzie River is a far better sea outlet than the Northern Dwina, on which Archangel is situated, and on which Russia solely depended

for maritime intercourse with the world until Peter the Great provided another at St. Peterburg; while at Fort Simpson, on the Mackenzie River, nearly 1000 miles north of the Oil fields nearest the Pacific Railway, the winter is not so long as the winter at St. Petersburg. The southern Oil fields experience warmer winters than many of the American states, and the climate is not so cold as in Manitoba. We may consequently strike the generalization that while Russia's Petroleum fields lie in the hot region of the Caspian (Old Persia), and the Petroleum fields of the United States in the cold-winter quarter of Pennsylvania and New York, England enjoys the double advantage of hot and cold Petroleum fields; those of Burma being a little hotter than Baku, and those of Western Canada a trifle colder than Pennsylvania. This advantage is something more than one to be held out as a mere inducement to fastidious capitalists, because Nature seems to have established a relation between the characteristics of crude Petroleum and the climate in which it is found. The Baku and Burmese Oils are essentially Oils for hot climates, while Pennsylvanian Petroleum is better adapted for temperate and cooler regions. I venture to predict, therefore, that when the great Oil fields of Canada are opened up, the Oil will be found to have an affinity with the Pennsylvanian, and will afford light not only for the future millions of the Dominion, but also for the present millions of the Pacific seaboard, both on the American side and in China and Japan.

Petroleum well worth looking up.

From 1859 to 1887 it is estimated that the United States exported 6,231,102,923 gallons of refined Oil, valued at £175,000,000. Not without reason, therefore, does the Canadian Senate Committee declare that the Athabasca Oil fields will doubtless "assume an enormous value in the near future," and, bearing in mind that Petroleum has attained a fourth place among United States exports, one can hardly deem the Committee unduly sanguine in predicting that "they will rank among the chief assets comprised in the Crown domain of the Dominion." That they are not situated on the actual seaboard is not a serious drawback, for those of the United

States are 300 or 400 miles inland, while the Baku Oil fields are distant 500 miles from the Black Sea. When the Caspian deposits were first exploited by the Nobels in 1876 there was no railway to Batoum, nor was the line opened until seven years later; communications in the meantime having to be maintained right across the continent of Europe, from the Baltic to the Caspian. Thus the Athabasca Oil fields, in their present state, are no worse off than those of Baku were when the Nobels took the Russian industry in hand, and put it on its legs. Even still more land-locked are the Oil fields of Galicia, situated in the very heart of Europe, and pierced by no great rivers, and yet whose success has been such as to tempt a considerable flow of British capital in that quarter.

Galicia in Favour.

The attitude of England towards Petroleum is very singular. She has invested nothing in the Oil industry of the United States, in which American capitalists have sunk hundreds of millions of dollars; and nothing in the Russian Oil fields at Baku, notwithstanding that the Rothschilds have embarked two millions sterling in the Caspian industry, and, last year, employed a whole fleet of steamers to convey Russian Oil to India. Even her own great deposits in Burma and Canada have attracted no capital, and if it be said in excuse that she has well developed the Shale Oil industry of Scotland, the reply must be made that Shale Oil is not Petroleum, that it cannot compete with it as an Oil—the Paraffin Oil of Scotland being merely a bye-product, and not the primary and profitable article of the trade—that the industry is practically devoted to producing manure (sulphate of ammonia), candles, and soap, and therefore lies quite outside the scope of these remarks. On the other hand, while ignoring the States and Russia, and leaving untouched Burma and Canada, England has played a leading rôle in the development of the Petroleum industry of Galicia. The 3200 wells there do not enjoy the prodigious yield of Baku bores; but the proper criterion is not what a well will produce in Oil, but what profit that Oil will produce in hard cash. In this respect the results in Galicia have been in some cases remarkably satisfactory; the

Lodyna Petroleum Syndicate, for instance, which only started operations in 1887, having since then derived sufficient profit from its Oil to pay two dividends at the rate of 20 per cent. The £1 shares of this concern are quoted at 37s. 6d., and are held in a few hands. It is interesting to note that while English capital has thus been advantageously invested in Galicia, the drilling there has been largely done by Canadians.

Successful Results in Galicia.

The Canadian system of drilling, in which, among other things, rods are used instead of ropes, as in Pennsylvania, seems to have given great satisfaction in Galicia, and the best wells have been sunk by means of it since first introduced by Mr. McGarvey, in 1882. The usual plan is to drive many small bores, instead of solitary large ones, as at Baku. When the wells were sunk on the Lodyna property, it was estimated that a production of three barrels a day, from a depth of 700 or 800 feet, would pay 100 per cent. on the cost of the bore. Some of the recent wells produce, instead, 9 to 18 barrels a day each, meaning a profit of from 300 to 600 per cent. As the estate is the largest held by any company in Galicia, and has an oil belt five miles long running right through it, success of this kind implies potentialities which well explain the Petroleum boom that has recently raged in Austro-Hungary. To protect the industry, a heavy duty exists on refined Petroleum, of which Austro-Hungary consumed nearly 40 million gallons in 1888. As the 55 refineries in Galicia produce as yet only six million gallons of refined Oil, there is still plenty of room for development. Meanwhile the wells of Galicia, yielding only about six million gallons of crude in 1874, now furnish 36 millions, varying in specific gravity from .750 to .950, and yielding from 30 to 60 gallons of refined Oil. In the Oil fields are employed over 12,000 men, and the number engaged in the industry is yearly increasing with the development of the trade. If, therefore, in land-locked Galicia such results are attainable in a few short years, the question may be pertinently put—What would be the effect of similar English energy bestowed on Burma and

Canada? With such successes as the Lodyna enterprise staring England in the face, and attracting more capital to Galicia, why should not Petroleum share some of the favour lately shown to gold mining operations? Many an Oil-well has yielded as much hard cash as a gold mine, as colossal fortunes made from Petroleum in America, Russia, and Galicia testify.

The Boom in Tank Steamers.

While the production of Oil has been pushed to a remarkable degree in Galicia, Russia, and the United States, England has sat at home, quite content to buy all her Petroleum of the foreigner—her own Whale Oil industry, her West African Palm Oil industry, and her Indian Vegetable Oil industry in the meanwhile decaying into insignificance under the influence of the new Mineral Oil enterprise of foreign rivals. In one branch alone has she given any evidence of activity, and even in that she had to be taught like a little child by the Russians and the Germans. The tank steamer first came into practical existence on the Caspian Sea. As that sea is large enough to float the British Isles, and still leave room for navigation, I insisted on my return from Baku in 1883, that if such vessels could weather the sudden tempests common to the Caspian, they could successfully ply on the ocean. This opinion was ridiculed by Petroleum merchants, and attacked in the Press by those who claimed to have a knowledge of the sea, and, while the wrangling was at its height, the Russians quietly stepped in and placed the Swedish-built tank steamer *Sviet* on the Black Sea, to run from Batoum to Odessa and the Mediterranean. After a few voyages this pioneer vessel brought a cargo of 1700 tons of lamp Oil round to London, weathering a gale in the Bay of Biscay. Even this failed to convince the Petroleum merchants of England, and it was left for the Germans to order of Messrs. Sir W. G. Armstrong, Mitchell & Co. the first tank steamer for the Atlantic trade—the *Glückauf*, of 2600 tons cargo capacity, built from the designs of Mr. Henry F. Swan, one of their directors, to whose skill and ingenuity are due the overcoming of the difficulties incidental to the designing of colossal

tank steamers for ocean service. The largest tank steamer on the Caspian Sea has a cargo capacity of 800 tons—the newer ocean Oil carriers, built on the Tyne, exceed 4000 tons. In the Caspian region there were nearly 40 tank steamers in 1883—there are now 100 afloat there. The *Glückauf* crossed the Atlantic in 1886—there are now 45 ocean tank steamers afloat or building; proving the swiftness of the revolution from barrel-carrying sailing vessels to steamers conveying the Oil in tanks.

Tank Steamers—Safe and Unsafe.

The Germans not only led the way in this revolution, but they led it in the right direction, ordering specially-built tank steamer after steamer, while the English trade pottered with "converted steamers"—i.e., old steamers roughly fitted with tanks. The difference between the two was not long in showing itself. In transporting oil in bulk, the chief point the constructor should have in view is to build his steamer in such a manner that absolute control shall be exercised over every drop of Oil on board the vessel, and every emanation of gas given off by that Oil. The converted steamers had numerous waste and inaccessible spaces outside the tanks, and these provided dangerous lodgments for leakage Oil and gas. Hence the *Petria* explosion at Liverpool in December, 1887. In building new steamers it was possible to avoid this, and it was avoided in the steamers built by Messrs. Armstrong, Mitchell & Co., who have constructed more than half the ocean-going tank steamers afloat to-day; but there were others, Russian as well as English, in which, while limiting the number of inaccessible places outside the tanks, there was not established that absolute control over leakage Oil and gas, which I have declared to be the primary and all-important safety essential of a sound tank steamer. In some there was not only inadequate control over leakage, but the tanks were not built so that every drop of Oil could be drained from them. These defects will assume their proper significance when it is explained that a tank steamer is chiefly liable to danger, not when full, but when empty, in the same way that if a lighted match be dropped into a barrel

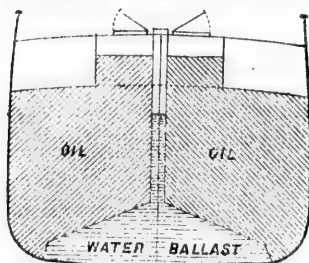
full of Petroleum the Oil will simply extinguish the flame, whereas, if dropped into an empty barrel, in which the drainage Oil has generated a little gas, there may follow an explosion. In one word, explosions do not proceed from the Oil, but from the gas given off by it.

How Explosions Originate.

This gas is in proportion to the surface exposed to the atmosphere. The larger the surface the more the gas. A tank steamer laden with a million gallons of Oil, filling the tanks up to the narrow necks of the deck expansion chambers, exposes, in proportion, no more gas-generating surface than a Petroleum barrel, if the bung be removed and the barrel filled right up to the bung-hole, thereby leaving an area of exposure only the size of the bung-hole. The moment a tank is empty, however, the Oil-dripping sides and the bottom, or the bottom alone, present a large area of exposure. The matter was very aptly illustrated at an official committee meeting in Russia last year. Experts were discussing the storage of Oil, and one of them placed on the table a *vedro* vodka bottle, holding nearly three gallons of Kerosene. A *vedro*, or carboy, has a very narrow neck, a little over an inch in diameter, and the area of exposure therefore did not amount to that of a dessert spoonful of Oil. No one noticed the presence of the Oil until the meeting was half over, when the *vedro* was taken away and replaced by a large soup-plate, on which had been poured sufficient Oil out of the *vedro* to just cover the surface. In a few minutes the warm air of the room began to act on the Oil, and soon there were complaints of the "smell of Kerosene" from members of the committee, who until then had been ignorant of the presence of both carboy and plate. The expert then explained how he had practically demonstrated that a spoonful or two of Oil, spread thinly over a large surface, gave out more gas than nearly three gallons stored in a narrow-necked bottle; and the illustration, which he applied to storage tanks on shore, with equal appropriateness indicates the difference between a tank steamer full and a tank steamer empty.

Safety Tank Steamers.

It follows, therefore, that if absolute control can be instituted over the drainage inside the tank, and the leakage from the tank into the vessel, all chance of danger will be eliminated; since obviously, if there be no Oil eluding control, there can be no gas, and if no gas, then no danger. Originally shippers insisted on no water-ballast being carried in the tanks, and as absolute control could not be exercised over Oil and gas in vessels with flat inner bottoms, Mr. Swan conceived the idea of "conical bottom" tank steamers. These consist of a series of tanks divided by a longitudinal bulk-head, resting on a conical-shaped water-ballast bottom.



SECTION OF TANK STEAMER, WITH CONICAL BOTTOM.

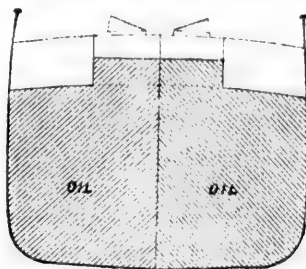
This causes the Oil tank to slope into a trough, from which the Oil can be completely drained with the greatest ease, thereby fulfilling the conditions of safety, laid down as regards the inside of the tank. Now, if the tank leak, it can only leak through the skin of the ship into

the sea, or into the conical-shaped water-ballast-way running along the bottom of the ship—a water compartment so large that a man can walk upright along it from one end of the vessel to the other, and repair any leaks. If any leaking takes place into this conical compartment, all that requires to be done is to fill it with water, the Oil then floats to the top of the water, and travels with it up trunkways, running (like chimneys) from the conical compartment to the deck of the ship, whence it flows overboard. In this manner every drop of leakage is effectually secured and expelled, and all accumulations of Oil and gas prevented.

Explosions Quite Preventible.

Latterly it has come to be accepted that water ballast may be carried in the tanks without injury to the Oil, and therefore most

of the recent vessels built by the Armstrong firm have no double



SECTION OF TANK STEAMER WITHOUT
WATER-BALLAST BOTTOM.

bottom at all. All the same, when bulk transport develops a little more, above all to the East, and vessels on the return voyage are required to bring other cargoes, a reversion to the conical bottom will probably be found necessary, on account of the readiness with which the smooth plating of that form of bottom can be

cleansed from all traces of Oil, and the vessel adapted for the conveyance of other goods. Of course, if a captain, after discharging his cargo, allows, from negligence or laziness, Oil drainage to remain in the tank, or leakage to exist in the water-ballast compartment, and in either case permits naked lights to be introduced, then danger may arise; but this danger ought no more to be saddled on the tank steamers than the danger of coal gas exploding in coal bunkers (to prevent which the use of naked lights therein is prohibited) is saddled upon steamers in general. The recent explosion on the *Ville de Calais* would not have occurred had this very ordinary precaution been observed. Used for conveying crude Petroleum, which is more gaseous than Kerosene, she was specially fitted with pipes to enable the gas to escape at the mast-head. Instead of closing the hatches, however, while the water ballast was running in, the attendant not only left them open but looked into them with a lamp, thereby bringing the escaping gas into contact with the light, and causing, as might have been expected, an explosion.

Argosies of Oil.

All the same, owing to the difficulty of getting at and controlling leakage in barrel-laden ships when full, and removing the Oil and gas when empty, they are far more dangerous than even the worst types of tank steamers, while they contain none of the safety elements peculiar to the latter. Owing to the isolation of

the numerous tanks, and the extra strong riveting to prevent leakage, modern Oil carriers are practically non-sinkable, even apart from their enormous pumping power. Some of the latest vessels, built by Messrs. Armstrong, Mitchell & Co., for instance, the *Darial*, *Elbruz*, and *Kazbek*, having a carrying capacity of over 4000 tons, equal to more than 1,100,000 gallons of Oil, can be pumped clean out in 12 hours. The loading or discharge of a similar cargo in barrels would be a matter of two or three weeks. All these tank steamers are fitted with the electric light. As shown in the sketches, which represent Mr. H. F. Swan's patented designs as regards "conical bottoms" and "expansion trunks," by partially filling the expansion trunks, the main body of the liquid cargo under deck is kept from moving, while at the same time allowing for the expansion or contraction of the Oil under varying temperatures. The united cargo capacity of the 45 ocean tank steamers now built or building exceeds 130,000 tons—the equivalent of quite 36 million gallons of lamp Oil. What, therefore, with the opening up of new Oil fields, and the development of the bulk system, there is little chance of a revival of the "good old times," when lamp Oil cost 2s. 6d. or 3s. a gallon. The wholesale price now ranges from 5d. to 6d. in London, and will doubtless become even cheaper when Russian transport improves; a glut at Baku often causing Kerosene to be sold there at a halfpenny a gallon.

Gas Yielding to Oil.

One result of this cheapening of Petroleum Oil is that Gas Companies find it, to use the words of the Chairman of the South Metropolitan Gas Company, a "more formidable competitor than even the electric light." And no wonder, for if in London districts, where gas costs 2s. 3d. a thousand feet, shopkeepers are giving up gas for Oil (two or three hundred, for instance, have lately done so in the Woolwich and Plumstead districts, and the same tendency is observable elsewhere), how much greater the competition in provincial towns where the price of gas is double or treble? To quote no remoter instances, the town of Erith, quite close to the Metropolis, last year gave up gas, and adopted Oil, openly inviting ten-

ders for the latter, and making a three years' contract with the Defries Safety Lamp Company, by virtue of which their new pneumatic lamps (Wolf Defries and Feeny's Patent) took the place of gas at two-thirds the cost per light, each light in turn being double the intensity of the one replaced. In New Southgate, last November, I had occasion to come into personal contact with this anti-gas movement. Discontented at paying 4s. 6d. per thousand feet, the inhabitants held a public meeting, and the gas company being obdurate, they pledged themselves to boycott gas. Accordingly, a committee was appointed to invite lamp manufacturers to send lamps to a local exhibition, and a request was despatched to me to open it with an address on Petroleum. I have not space to go into details of the comparisons instituted between gas and Petroleum; suffice it to mention that, taking a Defries circular-wick lamp as a representative of the new large-power lamps that have come into use of late years, relegating the duplex to the background, no difficulty was experienced in demonstrating that with Oil at 8d. per gallon, and gas at 4s. 6d. per thousand feet, a person burning £50 in gas-light a year, could have a corresponding amount of light from lamps for £10, thereby saving £40 a year, or, what is more customary, being able to use more light on the premises. If these figures seem calculated to excite incredulity, I need simply ask the critic to open his eyes when he next walks about the suburbs of London, or even in London itself, and he will be surprised at the number of shopkeepers burning new lamps of from 40 to 100 candle power. The small London shopkeeper is so desperately conservative that he does not pull down gas and instal Petroleum lamps unless the exchange is very considerably to his advantage.

London Lit with Oil again.

As a matter of fact, even in the very heart of London, and with Oil at 8d. per gallon, Petroleum light is less than one-third the price of gas, while it is purer, less destructive to goods, and, if *real* safety lamps be used, safer. In the Grand Hotel, Hotel Métropole, and other hotels where the electric light was once exclusively used,

several hundred large-power Petroleum lamps have recently been installed, and within the last few weeks Holborn Viaduct has been experimentally lit with Defries pneumatic Oil Lamps by the order of the Corporation. These have overhead reservoirs containing a supply of oil for 24 hours, and in the case of the Holborn Circus lamps, give a light of 150 candle power each. By the arrangement at Erith, the ratepayers there will save over £1500 in three years, and in the meanwhile have lamps of 30 candle power, instead of 15 candle power gas lights in their streets. The cost per gas jet of 15 candle power (often only 12 or 13) ranges between £3 10s. in large towns to £4 10s. or £5 a year in small towns. The cost per pneumatic lamp of 30 candle power, including labour, oil, &c., is £2 7s. a year. Every fractional fall in the price of Petroleum makes it possible to lower even this price, and renders the competition with gas still acuter. The prediction, therefore, may be safely hazarded that the action of the Local Boards at Erith, Bromley, Snodlands, and other places will be followed elsewhere in the provinces, and the gas monopoly will have a very bad time of it. As for the metropolis, if "London lit with Oil again" seems to imply a relapse, I would repeat what I have said before, that the return to Oil lighting is not to the vegetable and animal Oil lighting of the ancients, and the feeble 5 or 10 candle power glimmers of the ancients, but to Petroleum Oil, an Oil no older than the Crimean War, and to pneumatic masses of blaze, of from 30 to 150 candle power, of yesterday's invention.

Petroleum Gas and Coal Gas.

This formidable competition of Petroleum has caused some of the great gas companies to consider whether it would not be wise to replace coal with Oil in the manufacture of gas. For some weeks past the Gas Light and Coke Company has been experimenting at Beckton with Avery gas—an oil gas that has been very successful in America, and has attracted some attention in this country. If Russia may claim credit for having in the Caspian successfully

reduced from theory to practice the transport of Oil in bulk, and the use of liquid fuel, the United States may claim to have given the chief impulse to Petroleum gas. This is due to the extraordinary development of "natural gas" (which is simply "natural" Petroleum gas) in the States, and the opening up of new Oil fields, furnishing inferior Kerosene but excellent Fuel Oil. From the Lima Oil field, Ohio, the Standard Oil Company laid down last year an 8-inch pipe line to Chicago, 210 miles long, at a cost of half-a-million sterling, solely to pipe Oil for fuel and gas to that city. There, it is rapidly displacing coal in the factories. Formerly, the use of liquid fuel was confined to Russia, but now it has commenced to be largely employed on American railways, and at present over 1,000 locomotives and steamers in Russia and America use Oil for fuel and nothing else. In 1887 the consumption of "natural" or Petroleum gas in the States, estimated by the coal displaced, was equivalent to a displacement of 6,353,000 tons, valued at nearly two millions sterling. Thanks to the increasing abundance of Fuel Oil, such Petroleum gas systems as the Avery have had chances of development in the States hitherto denied in this country, owing to the absence of Oil fields; but this is now changing, in consequence of the rapid growth of the tank steamer fleet, which allows vast quantities of all kinds of Oil to be cheaply transported from one place to another. I am of opinion that the Standard Oil Company, which 18 months ago established a "Fuel Oil Branch" to supply America with cheap liquid fuel, will find it advantageous to extend this trade to Europe. It would also certainly pay to transport Burmese crude hither, and we may yet see the oily Irawady feeding the great gasworks at Beckton instead of the coaly Tyne.

Who is to "Boss" the Oil Age?

If this revolution is to take place, am I not right in asking that it should be done with the resources of the Empire, and not with those of foreign rivals? Is it not, I also demand, a matter of Imperial concern that the native Oil trade in India should be

protected against the inrush of cheap Russian Kerosene—protected in the sense that England and India shall do something to develop the vast Petroleum resources of Burma, and thereby make up for the decay of the vegetable Oil industry of India? If Petroleum Oil is to supersede Coal to any serious extent, let us, in the name of common sense, replace the superseded article with our own Oil, and not let America and Russia dominate the whole world with their Petroleum, cutting out our coal and extinguishing the vegetable and other Oil industries of the Empire. The people of India have a right to expect that the Indian Government shall do something to demonstrate the value of the Burmese resources, in the same way that the people of Canada will look (and judging from past events, will not look in vain) to the Canadian Government to aid the development of the great Oil treasures of the Mackenzie Basin. At the same time, seeing how abjectly dependent England is on the American and Russian Oil trade, although possessing such vast Petroleum resources of her own, both Burma and Canada have a corresponding right to expect that the Mother Country shall also do something on her part to open up the Oil resources of that Empire, of which the well-being of one section is the interest of all sections. To each and to all, it cannot but be an ardent desire that the English should be in the forefront of the Oil trade, whether at home, or in Canada, or in newly-annexed Burma—on the very fringe of the million-peopled provinces of Western China, at present totally unsupplied with Petroleum Oil, but bound to become customers of Russia and America, unless we play our proper part in the Coming Oil Age.

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